Section 83 Railings and Barriers

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4-8301 General

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Railings and barriers are used to reduce the severity of run-off-road accidents, to prevent out-of-control vehicles from crossing the median, and to decelerate errant vehicles. Construction personnel involved in the installation of railings, barriers, and other traffic safety systems should be familiar with Chapter 7, "Traffic Safety Systems," of the *Traffic Manual*. Chapter 7 discusses concepts and design considerations for traffic safety systems, including railings and barriers.

The following paragraphs discuss some of the details considered during design. The discussion centers on metal beam guard railing but can be applied to other types of railings and barriers.

The design for guardrail with end anchors contains many subtle details, the basis for which may not be readily apparent. Pay special attention to all connection details.

Impact tests and automobile configurations show that the specified height of 660 mm to 685 mm is necessary to prevent errant vehicles from climbing over the guardrail. Spacing posts 1905 mm apart provides resistance to guardrail deflection on impact and also lessens the tendency of the guardrail to form a pocket during impact.

A block spaces the guardrail out from the post. As a result, the contact area is moved away from the post so that little possibility exists of a vehicle snagging on the post. Also, the block allows the guardrail to rise slightly on initial impact, reducing a vehicle's potential for rolling.

When timber shrinks, it introduces enough slack in the mounting bolts to allow the timber blocks to rotate. Toenailing the blocks prevents this rotation.

When timber posts are used, the specified washers prevent bolts from pulling through when a vehicle strikes the guardrail. Also, during installation, the square hole in the plate washer will keep the carriage bolt from rotating.

For anchoring guardrail, anchor cables should be drawn up tautly. Cable clips must be installed correctly with the "U" on the short end of the cable and the saddle on the working end. Chapter 7 of the *Traffic Manual* discusses guardrail anchorage.

The metal box spacer used at the "structure" end of an approach guardrail allows the guardrail to approach the structure on a straight line and minimizes the possibility of vehicles snagging on the end of the bridge railing.

Frequently, when lateral clearances are limited, a proprietary end terminal system will be specified. When the plans and special provisions require end terminal systems, ensure the systems are installed according to the manufacturers' instructions.

4-8302 Before Work Begins

Before work begins, take the following steps:

- Carefully review the required details, and ensure construction conforms to them. Review the locations in the field, and decide whether any changes are necessary.
- If drainage inlets or other obstructions conflict with the planned locations for guardrail posts, consider using long span nested guardrail. (Refer to Chapter 7-03.5, "Design Considerations," and Figure 7.5 of the *Traffic Manual*.) Also, for information, consult with the district traffic engineer. If the contract does not provide for long span nested guardrail, a contract change order will be necessary.
- Verify the receipt and proper distribution of Form CEM-3101, "Notice of Materials to Be Used," which lists all fabricated materials. Examine the material as it arrives on the project to ensure the material meets specifications. Refer to Table 6-2.1, "Inspection of Fabricated and Manufactured Materials" in Section 6-2, "Acceptance of Manufactured Material and Sampling Methods," of the *Construction Manual* (manual).
- Look for the identification tags or markings that indicate the Office of Materials Engineering and Testing Services (METS) previously inspected the materials. If the materials are properly identified as previously inspected, project personnel do not need the certificates of compliance or mill test reports. Normally, the METS inspector will have obtained these documents.
- Ensure that markers and delineators for railings and barriers are the correct type and are covered by a Certificate of Compliance in accordance with the section titled "Prequalified and Tested Signing and Delineation Materials" in the special provisions.
- Review the contractor's stakes and layout work. Ascertain that offsets and flares for guardrail will be installed as shown on the plans.
- When connections to structures are required, coordinate this task with the Office of Structure Construction.
- Ensure all concrete mix designs have been approved before use.
- When applicable, discuss the allocation of work with the Office of Structure Construction.
- Review all shop plans for metal railing on structures.
- To avoid possible conflicts, verify scupper and side drain locations.
- To avoid possible conflicts, verify pull box and conduit locations.

4-8303 During the Course of Work

Once work begins, take the steps below for the following types of railings and barriers:

4-8303A Metal Beam Guard Railing and Thrie Beam Barrier

For this type of guardrail and barrier, do the following:

- Measure wood posts at the job site to ensure they conform to the specifications.
- When required, ensure that bolt holes in treated posts are filled with grease. Make a note of this inspection in the daily report.

- Ensure that the backfilling of postholes conforms to specifications. Posts should be set to the full depth shown on the plans. When spread footings or other underground obstructions interfere with placing at full depth, refer to the *Standard Plans* for alternatives.
- Periodically measure the spacing of posts.
- Ensure that blocks for metal beam guard railing are toenailed to timber posts.
- Ensure that rail elements are lapped so that the exposed ends will not face approaching traffic. Check bolts for tightness and threaded rods for proper trimming.
- Measure the height of the guardrail and barrier above the ground to ensure that the height conforms to the plans.
- Ensure that connections to bridge railings, retaining walls, abutments, or other flat surfaces comply with specifications. When high-strength bolts are required, check the markings on the bolts to ensure they also match specifications. When necessary, consult with district laboratory personnel about the proper markings.
- Ensure that anchor assemblies are constructed as specified. Cable clips should be installed in the proper direction and tightened to the required torque. The METS inspector will normally have obtained, when required for testing, a sample cable with swaged fitting. Therefore, if cable is properly identified as previously inspected, project personnel do not need to obtain a sample.
- When posts are installed in loose soil or near embankment edges, it may be necessary to use longer posts or some design modifications to ensure a barrier with adequate strength. Refer to Sheet A77FA in the *Standard Plans*.
- Immediately before placing concrete, ensure that holes for concrete anchors and footings are excavated to the dimensions shown on the plans.
- Ensure that anchor cables are tight enough to prevent any obvious slack in the cable once the footing concrete has cured for the required period.
- Direct the disposal of surplus material from excavation. When traffic is using an adjacent lane, prohibit spoil piles or windrows of material to remain in front of guardrail or median barriers. Such material alters the effective height of the railings and barriers.
- Ensure that asphalt concrete dikes are positioned under the guardrail as shown on the plans.
- Bolts or threaded rods must be long enough so that the nuts are threaded completely onto the bolt. Ensure that no more than 13 mm of thread is exposed on the traffic side of the guardrail as shown on the plans.
- Ensure the construction of flares conforms to the plans.
- Keep adequate records and make sufficient measurements to support both partial and final payment.

4-8303B Pipe Handrailing, Steel Bridge Railing, Cable Railing, Metal Railing (Tubular), and Chain Link Railing

For these types of railings, do the following:

- Ensure materials and methods used in anchorage and connections conform to the specifications and the plans.
- Ensure the contractor connects, stretches and tightens cables, chain link fabric, and tension wires as required.
- Check railings for proper alignment, appearance, and workmanship.

4-8303C Concrete Barriers and Railing

For concrete barriers and railing, do the following:

- Prohibit the placement of concrete barriers or railing on new structures until after the falsework is released. The Office of Structure Construction will provide height adjustments to compensate for camber and dead load deflections.
- Review the specifications for closing temporary gaps in barriers during construction. Determine that the contractor has planned this work before removing existing barriers or constructing new barriers. Ensure that blunt ends exposed to traffic are adequately protected. Refer to the "Public Safety" section in the special provisions.
- Ensure forms comply with Section 51-1.05, "Forms," of the *Standard Specifications* For additional guidelines, see Section 4-51, "Concrete Structures," of this manual.
- When extrusion or slipform machines are used to construct concrete barriers, inspect the grade upon which the machine will ride to determine if the grade is smooth enough to prevent foreseeable violations of specified tolerances. Check the guide wires for any obvious variations or measurable sags between supporting stakes.
- Ensure that the placing of bar reinforcing steel conforms to specified requirements and the details shown on the plans. For guidelines, see Section 4-52, "Reinforcement," of this manual.
- Review the applicable specifications for producing, placing, finishing, and curing portland cement concrete to be used in concrete railing and barriers. For guidelines, refer to Section 4-51, "Concrete Structures," and Section 4-90, "Portland Cement Concrete," of this manual.
- Require that the forms for Type 50 and Type 60 series barrier are stripped early enough so that the concrete surface may be given a light brush finish without resorting to tempering with grout.
- During the placing of extruded or slipform barriers, the design of the concrete and placing method should be such that no hand finishing, other than a light brush finish, is required. The surface of the traffic side of the concrete median barrier should be as smooth as possible. Prohibit heavy brooming or any other activity that will leave a roughly textured finish.
- Observe the abrasive blast finish applied to Type 50 and Type 60 series concrete barriers. The surface should have a uniform appearance, without heavy texturing.

4-8304 Measurement and Payment

Measure railings, barriers, and terminal systems as specified and, where appropriate, to the limits shown on the plans. Also, by counting, determine the number of cable anchor assemblies and connections to be paid for.

4-8304 Measurement and Payment